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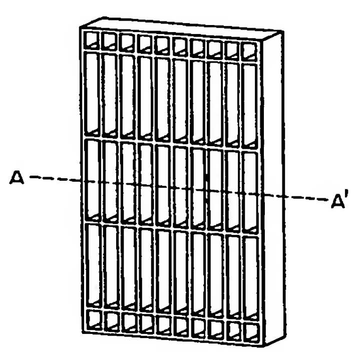
(54) See-through concrete form.

(57) A concrete form a part of which is made of a fiber-reinforced thermoplastic resin, said fiber-reinforced thermoplastic resin satisfying the following conditions:

$$Tt(C) \geq Tt(M) - 1.5\alpha$$
$$15 \leq Tt(C)$$

wherein Tt(C) (%) is total transmittance of the fiber-reinforced thermoplastic resin measured at the thickness of top board, α (% by weight) is fiber weight fraction of the fiber-reinforced thermoplastic resin, and Tt(M) (%) is total transmittance of the matrix resin measured at the same thickness as above.

FIG. 1



EP 0 623 434 A1

The present invention relates to a see-through concrete form through which the state of concrete packed in the concrete form can be inspected at the time of concrete placing.

As concrete form, forms made of woody materials such as southern sea's timber and the like have so far been used. When concrete is placed in those concrete forms having no see-through property, however, the state of concrete packed in the form cannot be inspected visually. Thus, when the concrete packed in a form is in a defective state such as having a gap between form and concrete, it has been sometimes necessary to destroy the once produced construction after the concrete-placing and to place concrete again.

For such a reason, the use of a transparent synthetic resin board as a concrete form has been proposed (Japanese Patent Application KOKAI No. 64-80665, No. 1-94159, etc.). However, this transparent synthetic resin board is inferior in stiffness and impact strength, and can exhibit a sufficient strength as a concrete form only when an additional measure such as increasing the thickness of the top, bonding a crosspiece, etc. is taken.

In view of above, the present inventors conducted studies with the aim of developing a concrete form having a sufficient strength as a concrete form and a transparency enough to enable a visual inspection of the state of concrete packed in the form. Based on the studies, the present invention was accomplished.

Thus, the present invention provides a concrete form a part of which is made of a fiber-reinforced thermoplastic resin, said fiber-reinforced thermoplastic resin satisfying the following conditions:

$$Tt(C) \geq Tt(M) - 1.5\alpha$$
$$15 \leq Tt(C)$$

wherein Tt(C) (%) is total transmittance of the fiber-reinforced thermoplastic resin measured at the thickness of top board, α (% by weight) is fiber weight fraction in the fiber-reinforced thermoplastic resin, and Tt(M) (%) is total transmittance of the matrix resin measured at the same thickness as above.

The invention will be described in detail in connection with the drawings in which:

Fig. 1 illustrates one embodiment of the present concrete form having a number of ribs on backside from the rib side;

Fig. 2 illustrates a sectional view of the concrete form at A-A' in Fig. 1, wherein:

6: top board, and
7: ribs; and

Fig. 3 illustrates the apparatus used for impact test of the concrete form according to one embodiment of the invention, wherein:

1: load,
2: point of impact,
3: test piece (top board),
4: bearer for test piece, and
5: tip of the point of impact.

A concrete form is required to have high stiffness and high impact strength. In the case of resin-made concrete form, a higher fiber weight fraction in the used fiber-reinforced resin gives a higher strength and a lower see-through property. At a fixed fiber weight fraction, a higher total transmittance of the matrix resin gives the fiber-reinforced resin a better see-through property.

In order to exhibit a good see-through property while retaining a high strength as a concrete form, a fiber-reinforced resin must have a total transmittance not smaller than a certain standard value. When thickness of a fiber-reinforced resin is fixed, total transmittance of resin board Tt(C) is dependent on the fiber weight fraction α(% by weight) and the total transmittance of matrix resin Tt(M) (%), and a sufficient see-through property can be exhibited when the following conditions are satisfied, as has been mentioned above:

$$Tt(C) \geq Tt(M) - 1.5\alpha$$
$$15 \leq Tt(C)$$

When total transmittance of the fiber-reinforced resin does not satisfy the above conditions, the total transmittance markedly decreases as the fiber weight fraction increases, as a result of which no sufficient see-through property can be achieved when such a fiber-reinforced resin is made into a concrete form having a necessary strength.

The thermoplastic resin used as a base material for the concrete form of the invention is not critical, so far as the resin has a strength enough to be usable as a concrete form. Thermoplastic resins such as

polyethylene, polypropylene, ABS resin, vinyl chloride resin, PMMA, nylon, polycarbonate resin and the like can be used for this purpose. Among these resins, polypropylene is preferred from the viewpoint of heat resistance, strength and economy.

As the reinforcing fiber, glass fiber is preferred, though other fibers such as alumina fiber and the like are also usable non-limitatively.

The fiber weight fraction may be any value, so far as it is in the range defined above. From the viewpoint of strength and economy, however, the fiber weight fraction is usually from 10 to 50% by weight, and preferably from 15 to 30% by weight.

When glass fiber is used, the fiber length is usually from 0.1 to 50 mm, and preferably from 1 to 15 mm. The fiber diameter is usually from 1 to 50 µm.

A binder may be incorporated into the present fiber-reinforced resin for the purpose of improving the adhesiveness between fiber and resin, so long as the total transmittance satisfies the above-mentioned conditions.

Needless to say, other compounding additives conventionally added to thermoplastic resins, such as stabilizers, colorants, fillers and the like, may also be incorporated into the fiber-reinforced resin, so long as total transmittance satisfies the above-mentioned conditions.

The structure of the concrete form of the present invention, made of a thermoplastic resin, is not critical. It may be a flat board composed of top board 6 only, or the top board may have a number of ribs 7 on backside to form a comb-like section.

The process for producing the concrete form of the present invention is not particularly limited, but conventional resin forming processes such as injection molding process, injection-compression molding process, and the like can be adopted.

In the concrete form of the present invention, the overall thickness of the form is not critical, so far as it is such a thickness as to give a necessary strength. Usually, the overall thickness is from about 10 mm to about 70 mm. Preferably, the overall thickness is from 10 mm to 15 mm in the case of flat board and from 62 mm to 65 mm in the case of rib-like structure, from the viewpoint of workability at the time of use and particularly in view of the relation to the so far widely used woody concrete form.

When concrete is placed by the use of the see-through concrete form of the present invention, there can be achieved an effect that the state of concrete packed in the form, such as presence or absence of gap and the like, can be inspected visually.

The invention will be illustrated in more detail with reference to the following examples. Needless to say, the present invention is by no means limited by these examples.

The testing methods used in the examples were as follows.

Total transmittance: This was measured according to JIS K7150-Revision, Method B. The apparatus used for the measurement was Integral Cube Type Reflecting Transmission Meter (Model RT-100, manufactured by Zaiko Shikisai Gijutsu Kenkyusho K. K.).

Bending test: This was measured according to eight points support method of JIS K7203.

Impact strength: The apparatus shown in Fig. 2 was used. An impact point having a 1/2 inch semicircular tip was placed on test piece having a size of 50 mm x 50 mm, and a load was let fall down thereon from upside. The minimum fall distance required for breakage of test piece (breaking height) was measured under a load, from which breaking energy was calculated according to the following equation, and the breaking energy was taken as "impact strength":

Breaking energy (kg•cm) = Load (kg) × Breaking height (cm)

Examples 1 and 2

A polypropylene pellet (matrix resin; AX574, manufactured by Sumitomo Chemical Co., Ltd.; MI = 45) containing a glass fiber (fiber length 6 mm, fiber diameter 13 µm) was fed into a plasticizing apparatus, and melted at 230°C. The melted fiber-reinforced resin was fed into the cavity between the dies of a male-female fitting type press through a melted resin feeding path provided in the female die while keeping the cavity clearance at about 10 mm. Then, the dies were clamped until the cavity clearance reached 2.5 mm, after which the dies were pressed and cooled to obtain a concrete form of rib-like structure having a width of 600 mm, a height of 900 mm and a thickness of 61.0 mm, as shown in Fig. 1. Dimensions of the concrete form thus obtained were as follows:

Thickness of top board: Height of rib: Rib width at joint to the top: Taper angle of rib:	2.5 mm 58.5 mm 3.5 mm 0.5 degree
Number of ribs:	11 in the total at equal intervals in the longitudinal direction (involving those present on the two side boards) 6 in the total in the lateral direction (involving those present on the two side boards and those present on the lines 150 mm and 650 mm distant from the two side boards).

Table 1 illustrates total transmittances of the matrix resin and the fiber-reinforced resin. Table 2 illustrates the properties of the thus obtained concrete form measured at the top part.

Examples 3-5

A concrete form was produced by repeating Example 1, except that a propylene pellet (matrix resin; AX574, manufactured by Sumitomo Chemical Co., Ltd.; MI = 45) containing a glass fiber having a fiber length of 0.1 mm or less and a fiber diameter of 10 µm was used.

Table 1 illustrates the total transmittances of the matrix resin and the fiber-reinforced resin, and Table 2 illustrates the properties of the thus obtained concrete form measured at the top part.

Comparative Examples 1 and 2

A glass fiber mat (VHM5075, manufactured by Nippon Byleen Co.) was held between the up and dies and a melted matrix resin (AX574, manufactured by Sumitomo Chemical Co., Ltd.; MI = 45) was fed thereto. Thereafter, the procedure of Example 1 was repeated to obtain a concrete form.

Table 1 illustrates the total transmittances of the matrix resin and the fiber-reinforced resin, and Table 2 illustrates the properties of the thus obtained concrete form measured at the top part.

Comparative Example 3

A concrete form was produced by repeating Example 1, except that a propylene pellet (matrix resin; AX574, manufactured by Sumitomo Chemical Co., Ltd.; MI = 45) containing a glass fiber having a fiber length of 0.1 mm or less and a fiber diameter of 10 µm was used.

Table 1 illustrates the total transmittances of the matrix resin and the fiber-reinforced resin, and Table 2 illustrates the properties of the thus obtained concrete form measured at the top part.

Table 1

	Matrix resin		Concrete form (Fiber-reinforced resin)		
	Thickness (mm)	Total transmittance Tt(M) (%)	Fiber weight fraction α (% by wt.)	Thickness (mm)	Total transmittance Tt(C) (%)
Example 1	2.5	52.4	30.1	2.5	50.1
" 2	3.5	46.1	31.2	3.5	42.3
" 3	2.5	52.4	20.3	2.5	44.9
" 4	4.8	39.8	33.3	4.8	16.3
" 5	2.5	52.4	20.1	2.5	23.8
Comparative Example 1	2.5	52.4	29.8	2.5	7.0
" 2	3.5	46.1	15.0	3.5	17.3
" 3	4.8	39.8	40.3	4.8	9.5

Table 2

	Bending strength (kg/cm^2)	Bending modulus (kg/cm^2)	Impact strength	See-through property
Example 1	1,150	44,000	○	○
" 2	1,100	21,000	○	○
" 3	800	38,000	△	○
" 4	1,250	50,000	○	○
" 5	900	41,000	△	○
Comparative Example 1	1,150	49,000	○	×
" 2	700	37,000	○	×
" 3	1,450	56,000	○	×

Claims

1. A concrete form a part of which is made of a fiber-reinforced thermoplastic resin, said fiber-reinforced thermoplastic resin satisfying the following conditions:

$Tt(C) \geqq Tt(M) - 1.5\alpha$
$15 \leqq Tt(C)$

wherein Tt(C) (%) is total transmittance of the fiber-reinforced thermoplastic resin measured at the thickness of top board, α (% by weight) is fiber weight fraction of the fiber-reinforced thermoplastic resin, and Tt(M) (%) is total transmittance of the matrix resin measured at the same thickness as above.

2. A concrete form according to Claim 1, wherein said matrix resin is polypropylene.

3. A concrete form according to Claim 1 or 2, wherein the fiber used for loading is a glass fiber having a fiber length of from 0.1 mm to 50 mm.

4. A concrete form according to Claim 1, 2 or 3, wherein the fiber weight fraction α is from 10% to 50% by weight.

FIG. 1

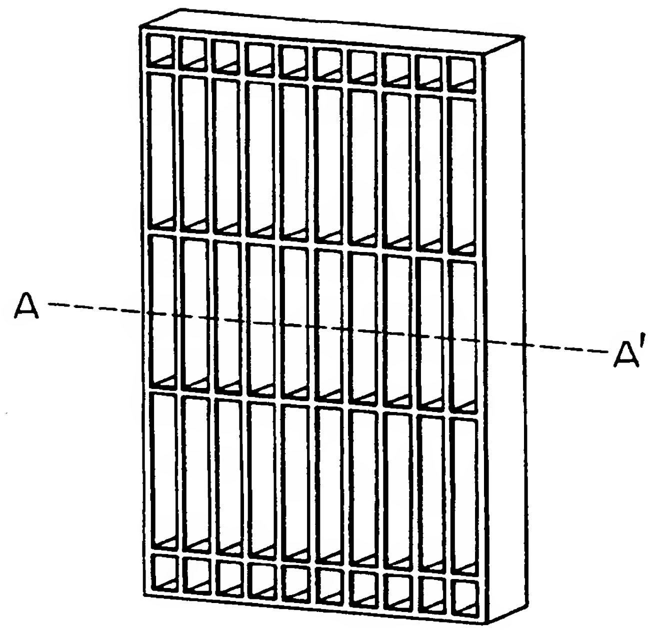


FIG. 2

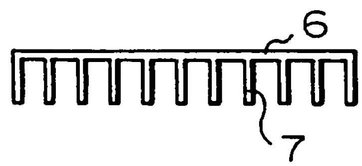
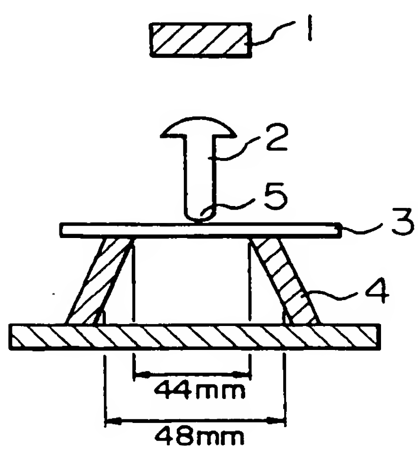


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 6479

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	DE-A-29 05 609 (BAUDEKORATION LUDWIG EDEL GMBH & CO KG) * the whole document * ---	1	B28B7/34 E04G9/05
A,P	DATABASE WPI Week 9330, Derwent Publications Ltd., London, GB; AN 93-239498 & JP-A-5 162 111 (NIPPON STEEL CHEM CO) 29 June 1993 * abstract * ---	1-4	
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 140 (M-950) (4083) 16 March 1990 & JP-A-02 008 459 (IDEMITSU N S G K.K.) 11 January 1990 * abstract * ---	1-4	
A	US-A-3 891 179 (M. BERMAN) * the whole document * ---	1	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
T	WO-A-94 09227 (SUMITOMO CHEMICAL COMPANY , LIMITED) * the whole document * -----	1-4	B28B E04G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 August 1994	Gourier, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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